5. Landfill Gas Contracts and Permitting

Chapter Overview

The purpose of this chapter is to provide an overview of the types of contracts needed to develop landfill gas (LFG) energy projects and the federal environmental regulations and permitting requirements that may affect LFG energy projects.

For landfill owner/operators, creating value from the sale of LFG, electricity generation, or environmental attributes through a contractual relationship with a buyer is one of the most critical elements to the success of an LFG energy project. This is particularly true if the project is intended to be financed. Entities providing the financing will be particularly interested in the terms and conditions of the agreement to transact the energy and environmental assets associated with the LFG energy project. The structure and potential risks in such contracts will have a direct impact on the terms offered by the financing entity. Therefore, both the landfill owner/operator and the project developer should thoroughly evaluate the elements of all contractual agreements, which represent an important step in the project development process.

This chapter provides guidance and considerations for landfill owner/operators and LFG energy project developers in securing contracts related to beneficial use and emission reduction projects. These contracts can be separated into three broad categories discussed in Sections 5.1 through 5.3:

- Power sales agreements (electrical generation projects)
- LFG purchase agreements (any beneficial use project type)
- Environmental attribute agreements (any project type)

Section 5.4 provides information for landfill owners and project developers about federal air quality, solid waste, and water quality regulations and permitting requirements that can pertain to LFG energy projects. The federal requirements are presented in general terms, as site-specific analyses are needed to determine which rules and permitting requirements apply to a particular LFG energy project, and each state has its own requirements for carrying out the rules and permitting programs.

5.1 Power Sales Agreements

Traditionally, electricity generated from an LFG energy project has been sold to investor-owned utilities (IOUs) that provide electrical service in the region where the project is located through a power purchase agreement (PPA). However, with the restructuring of the U.S. electricity sector in the late 1990s, non-regulated entities (e.g., independent power producers, co-operatives, municipalities, power marketers, and power purchasers) were given greater access to the electricity grid, which led to the creation of competitive electricity markets in many states and regions. With the advent of these markets, electricity can now be sold as a commodity, offering many more sales options to the power project developer/owner.

Landfill owners and project developers need to consider these sales carefully. The LFG energy project owner can now sell electricity and other attributes, including capacity, renewable attributes of the power, and ancillary services, as a "bundled" product, or sell them individually. Furthermore, the project owner can sell many of these electrical elements on either a daily basis or for a fixed term. Most LFG energy projects are "must run," meaning that they run all the time and are not dispatched by a system operator to meet variation in demand and electricity market price. Operators of dispatchable LFG electricity projects monitor market price and can bring the units on and off line to respond to electrical market prices; these projects are typically managed from a central location via remote connection to the facility's supervisory control and data acquisition (SCADA) systems. Dispatchable units give a project more flexibility to take advantage of price variations in the spot electrical markets.

Power Purchase Agreement With an IOU

Historically, the most common structure has been to sell the electricity to an IOU, cooperative, or municipal entity through a PPA. The electricity, including energy and capacity, is sold to the IOU at a fixed price with some kind of escalation or indexed price based on an estimate of short run avoided cost or some publicly available local market price mechanism. Environmental attributes related to electrical generation via LFG may or may not be included in the PPA. The sale of power alone, without environmental attributes, is known as "brown power," whereas the environmental attributes attributed to the generation of renewable energy are known as "green power." Executed PPAs might only address the transaction of brown power or might include some or all of the green power attributes. The green attributes related to electrical generation via LFG are discussed in greater detail in Section 5.3. These agreements are typically negotiated or obtained through a competitive bidding process. The terms of these contracts can vary greatly, from 1 to 15 years. Entities providing financing are most comfortable with traditional PPAs because of their predictable revenue stream. Financing entities prefer a PPA term equal to or longer than the term of the financing.

Power Sales Contract to a Power Marketer or Wholesale Buyer

LFG energy projects can sell their electricity to power marketers or wholesale buyers or to other market participants eligible to buy and/or sell electricity on these markets in states and regions with robust electricity markets where electricity pricing is transparent. Examples of such states/regions include the PJM Interconnection, the New York Independent System Operator, and the California Independent System Operator. The contract terms can vary widely, but below are two common forms:

- A fixed "bundled" rate that typically includes energy and capacity, and may include renewable attributes for power for a fixed term of 2 to 15 years. The rate can be adjusted annually for inflation.

- A variable rate for electricity (energy and/or capacity) at a premium or discount (depending on market conditions) to a publicly available market price for a fixed term. Rates may include a floor and/or ceiling price. Rates may adjust daily, monthly quarterly, bi-annually or annually. The term can be fixed for a period of 1 to 10 years.

Selling Directly Into a Market

Project developers/owners can sell directly into electricity markets for the market price for energy and capacity. The price for energy is usually determined theoretically a day ahead based on bids received, then updated in real time several times per hour (i.e., every 5 to 15 minutes) by the system operator. The market price is determined by the lowest marginal cost of the next generating unit to be dispatched and provide power to the system. Capacity is typically bid and prices determined for longer time periods — typically 1 to 6 months, but this varies. The renewable attributes of the power are not typically sold in these markets, but these markets may track and verify the production of these attributes.

Net Metering

In some states, net metering allows consumers, commercial, and industrial entities to offset their electrical use with appropriately sized renewable electric generation located on site. With net metering, the meter can run in either direction; customers are allowed to "bank" energy exported to the grid when their demand is low and import power from the grid when the generation is not operating or not able to fully meet their peak demand. States set their own net metering regulations and typically limit the capacity of the generation. Net metering is appropriate to consider:

- When the landfill or nearby business has an appropriately sized power load and meets the state net metering regulations.
- In regions with a high retail electric rate.
- Where grid interconnection costs make traditional grid-connected electric generation projects infeasible.

More information about net metering is available on the U.S. Department of Energy's Energy Efficiency and Renewable Energy Web site.

Other Consideration — Electric Grid Interconnection

In addition to contracting issues, LFG developers/owners must carefully consider the complexity, cost, and timing of interconnecting to the electric grid. Grid interconnection can be the most important issue in determining the feasibility of a project. Some factors that drive interconnection costs and timing include:

- Amount of megawatts (MW) the developer wants to connect to the grid.
- Size and capacity of surrounding distribution (12–15 kilovolt [kV]) and medium tension (20–69 kV) distribution lines.
- Location of the distribution substation.
- Interconnection procedures and regulations.
- Utility requirements (e.g., communications, protection, control).

These factors are highly dependent on the project's location and the utility's experience and willingness to interconnect with LFG energy and other distributed generation projects. In some regions and states, regional transmission operators (RTOs) and regulators are trying to make the interconnection process for small renewable projects more streamlined, transparent, and cost-effective. Early on in the project development cycle, the utility completes an interconnection feasibility study (paid for by the developer), which will define many of these issues. Project costs and timing can vary substantially among projects, so LFG energy developers should begin the interconnection process as early as possible and engage interconnection experts with experience in the state or region. An interconnect agreement will be required with the utility, as well as agreements for the design and construction of the interconnection.

5.2 LFG Purchase Agreements

A landfill owner/operator typically sells its electricity to a project developer or LFG end user for one of three purposes:

- For use as a substitute for other fuels (e.g., to fire boilers, kilns, furnaces) to create hot air, hot water, or steam. This is typically referred to as a direct-use project or as a medium–British thermal unit (Btu) project.
- To power an LFG-fired electricity generation facility.
- For injection into a natural gas distribution or transmission pipeline, after purification to natural gas pipeline standards (typically referred to as a high-Btu project).

Direct-Use Sales of Medium-Btu LFG

The three basic types of contracts for direct-use projects are fixed price, indexed price (where the cost of LFG is based on a discount of a posted natural gas price and will change over time), and a fixed/indexed hybrid approach. These contracts are usually set on a Btu delivered basis. The landfill owner/operator typically sells the delivered LFG at a discount to typical natural gas prices due to the following factors:

- The investment the developer and/or end user will need to make to transport and utilize the LFG (e.g., modification of existing equipment to burn LFG).
- Potentially higher operation and maintenance (O&M) costs due to the fact that LFG has more impurities than natural gas.
- The need for the end user to have backup fuels.

The level of discount is driven by the level of investment required to construct and operate the project and by how these costs are distributed among the participating parties.

Fixed Price Contracts. A guaranteed fixed price contract establishes a fixed price for the gas for a certain length of time. This price usually incorporates an escalator to account for inflation. The initial price for LFG is typically set at or below the average market price for natural gas and is based on

costs to implement the LFG energy project and return on investment required by the participating parties. Because of the volatility of the natural gas pricing and its sharp increase in price in this decade, fixed price contracts for LFG are becoming less common.

Indexed Sales Contracts. Indexed LFG sales contracts typically offer a discount off a posted market price for natural gas (typically 20 to 50 percent below the average monthly cost of natural gas on the selected indices such as Henry Hub or NYMEX). This discount can vary significantly depending on how much investment is required and who is responsible for the investment. When negotiating price with the end user, the owner of the LFG should consider that the end user may not have access to the natural gas wholesale pipeline pricing indicated in most commonly available indices (e.g., Henry Hub). Buyers must pay additional costs for transportation, infrastructure construction, and distribution of the natural gas, which can run $0.75 to $2.00 per million Btu higher than these wholesale indices. Because of the volatility of natural gas prices, indexed LFG sales contracts are highly variable in terms of revenue; however, they do provide the end user with considerable savings and a lower risk profile by always being below the market price of natural gas. Additionally, indexed contracts typically include provisions for maximum and minimum pricing (e.g., ceiling and floor prices) to limit price risks on both sides of the contract agreement. Setting a floor price limit is essential to reducing the risk to the seller of the LFG, particularly if the seller is making a significant investment. A financing entity typically requires setting a floor price to ensure that debt payments can be made in all market conditions. A price ceiling is essential if the LFG buyer is making a significant investment; it also provides an additional incentive to use LFG. Typically, if one party is requiring a floor price, the counterparty asks for a ceiling price, or vice versa.

Hybrid Contracts. LFG sales contracts have also been implemented in other creative ways in order to minimize risk and maximize economic benefit. One such option is a hybrid of the two previous types of contract. In an example hybrid contract, a fixed price contract is implemented for a certain period of time (e.g., until the capital investment is recovered) and then converted into an indexed price contract. Sales costs depend on the level of investment and equity participants.

Guarantees. LFG contracts may include a minimum guarantee on the quality and amount of LFG to be delivered and/or a minimum guarantee on the amount of gas that will be consumed (known as a "take or pay" clause). Landfills should consider factors such as equipment and wellfield problems when agreeing to a minimum guarantee on gas delivery. In addition, landfills that are closed or closing in the near future should be cautious about setting unreasonable gas quality limits. Conversely, the energy user should include any routine plant shut downs in setting a minimum consumption guarantee.

LFG Sales to an Electrical Generation Project

These contracts are similar to those developed under a direct-use project application as discussed above. The contractual relationships between the entity that owns/operates the electrical generating facility and the purchaser of the electricity is provided in greater detail in Section 5.1.

High-Btu Sales

If the LFG is purified to natural gas pipeline standards, it can be injected into a natural gas distribution or transmission line. The concentration of carbon dioxide, oxygen, nitrogen, and other impurities (e.g., volatile organic compounds, hazardous air pollutants, hydrogen sulfide, siloxanes) must be reduced to levels required by the gas pipeline owners. When LFG is sold onto a distribution line to be used in the region serviced by the distribution company, the LFG is typically sold on a Btu basis to the distribution company at an indexed price. When LFG is sold onto a natural gas transmission line that transports gas over longer distances before acceptance by regional distribution companies, a more complicated contract may be required with the gas transmission line company; such contracts will address the provision of transmission services to the ultimate purchaser of the LFG and will also include contract provisions with the ultimate purchaser. The LFG may ultimately be sold to a natural gas supplier, marketer, or distributor at a fixed price or at an indexed natural gas price appropriate for the location or point of delivery. The environmental attributes also could be included as part of this contract.

5.3 Environmental Attribute Agreements

The LFG energy project developer can potentially sell a project's environmental attributes for additional revenue, or to provide more revenue to the landfill owner. Broadly, there are two types of environmental attributes:

- The destruction of LFG methane (direct).
- The displacement of fossil fuel use via generation of energy from LFG, a renewable energy source (indirect).

These attributes can be sold together or separately depending on the market in which they are sold and the nature of the contract entered into by the landfill owner or LFG energy project owner.

All participants in LFG energy projects (landfill owner/operator, developer, other market participants) should ensure that ownership of the environmental attributes, including the rights to the greenhouse gas emission reductions, are clearly defined. Historically, LFG energy projects were relatively clear about who owned the LFG rights; however, as new environmental markets evolved and new incentives were created (e.g., renewable energy certificates, tax credits, and recently greenhouse gas credits), contract language has not always been clear. For example, in contracts that pre-date the greenhouse gas markets, ownership of this attribute was usually not defined in the contract. A clear definition of which party has ownership of the LFG rights and each of the environmental benefits is critical for new project agreements and amendments to older agreements. The term "environmental attributes" is used to broadly define all of these benefits (including greenhouse gas), both known and those to be defined at some point in the future.

In addition, landfill owners or LFG energy project developers can often quality for renewable energy tax credits or other incentives to improve project financial feasibility. See Chapter 4, Section 4.2, and the U.S. EPA Landfill Methane Outreach Program (LMOP) online funding guide for information about

various federal and state tax credits, tax exemptions, low-cost bonds, low-interest loans, and grants available to help finance LFG energy projects.

Greenhouse Gas Credits Derived From the Destruction of LFG

Methane is over 20 times more effective in trapping heat in the atmosphere than carbon dioxide over a 100-year period. The capture and destruction of the LFG, and its constituent methane, in a flare or other control device (e.g., internal combustion engine, gas turbine, boiler), results in a significant net reduction of greenhouse gas emissions. The greenhouse gas reductions achieved by the destruction of methane in LFG have market value and can be sold in voluntary and compliance markets. Essentially, an entity that wants, or is required, to reduce its greenhouse gas emissions can indirectly fund LFG collection and control projects through the purchase of greenhouse gas emission reduction credits from landfills. These greenhouse gas credits are traded in units of metric tons of carbon dioxide equivalent. Currently, greenhouse gas credits are traded in either a compliance or voluntary market; no single market nor single standard for the trade of greenhouse gas credit currently exists.

For a landfill's project to qualify for a greenhouse gas emission credit, the destruction of LFG must be "additional," meaning that the LFG must be collected and controlled voluntarily and cannot be required under regulations such as EPA's New Source Performance Standards (NSPS). Generally, a project does not qualify for greenhouse gas credits if the landfill is required to collect and control LFG under any local, state, or federal regulations for control of emissions, odors, and/or gas migration. Although buyers and markets vary, most require the LFG collection system to have been installed recently. Some buyers and markets will accept LFG collection systems that commenced operation as early as January 1, 1999.

Voluntary Markets. Most greenhouse gas transactions currently take place in the voluntary market, which is composed of markets, buyers, brokers, and aggregators who are voluntarily buying greenhouse gas credits with the goal of reducing the buyer's carbon footprint. The voluntary market currently comprises the Chicago Climate Exchange (CCX) and several options in the over-the-counter (OTC) market.[1]

The CCX is an integrated greenhouse gas emissions registry and trading system. Its members make a voluntary but legally binding commitment to reduce greenhouse gas emissions 4 percent from a baseline period (1998–2001) by 2006 and 6 percent by 2010. Greenhouse gas credits are verified by a third party and sold on CCX's Web-based trading system.

Participants in the OTC market, or firms investing in greenhouse gas credit projects, will sign agreements with landfill owners to obtain the right to the greenhouse gas credits and may provide the investment funds for the LFG collection system in some situations. The structure of these agreements is variable and will primarily depend on the level of equity, if any, provided by the party interested in procuring the greenhouse gas credits. For agreements where the greenhouse gas investment firm provides equity for all or part of a gas collection and control system, contract

[1] Forging a Frontier: State of the Voluntary Carbon Markets 2008. Ecosystem Marketplace & New Carbon Finance. May 8, 2008.

structures may provide ongoing revenue sharing or may allow the equity provider to recover their investment before revenue sharing with the landfill. Greenhouse gas agreements where equity is provided are typically longer-term agreements (up to 10 years) to minimize capital recovery risk by the investor. Simple greenhouse gas credit purchase agreements where significant equity is not provided can have a much wider range in agreement length. These non-equity greenhouse gas purchase agreements may address the transaction of a discrete amount of previously generated greenhouse gas credits, or may provide a longer-term (or forward) agreement for the rights to future greenhouse gas credit generation.

Because the voluntary greenhouse gas market is relatively new, no standardized methodology or protocol exists for determining eligibility of these credits. These voluntary markets and buyers operate using several different standards and protocols for determining project eligibility and verifying the greenhouse gas credits. A *standard* is the overall framework of a greenhouse gas program), whereas a *protocol* is a specific set of requirements that outline how greenhouse gas credits are developed for a specific project, such as an LFG energy project. Carbon standards include Voluntary Carbon Standard, Gold Standard, GE-AES Greenhouse Gas Services, and California Climate Action Registry. Protocols outline project eligibility, monitoring, recordkeeping, quantification, and reporting requirements. Greenhouse gas methodologies applicable to landfill projects in the voluntary markets currently include:

- California Climate Action Registry.
- Clean Development Mechanism (CDM) Consolidated Baseline and Monitoring Methodology for Landfill Gas Project Activities and CDM Methodological Tool to Determine Project Emissions from Flaring Gases Containing Methane.
- EPA Climate Leaders.
- GE-AES Greenhouse Gas Services.

Once the methane destruction from the LFG energy project has been quantified using the selected protocol, it must be converted into metric tons of carbon dioxide equivalent for trading. To do this, the amount of methane destroyed is multiplied by the global warming potential of methane, which can range from 21 to 25 depending on which greenhouse gas standard or protocol is used. Once a third party has verified the greenhouse gas credits, they may become verified emission reductions (VERs), carbon financial instruments (CFIs), or other protocol-defined instrument, depending on the market or the protocol used by the buyer.

Since most voluntary greenhouse gas transactions are not public information, the value for these greenhouse gas credits is not well established. According to a 2008 report,[2] average prices in 2007 for the CCX and OTC markets were $3.15 and $6.10 per metric ton of carbon dioxide equivalent, respectively. Prices within these two markets ranged from $1.62 to $300, with the $300 price observed on a single transaction only. The greenhouse gas credits generated by the voluntary

[2] Forging a Frontier: State of the Voluntary Carbon Markets 2008. Ecosystem Marketplace & New Carbon Finance. May 8, 2008.

collection and destruction of LFG at a landfill can be a significant revenue stream for the landfill owner of the LFG rights, as described in Chapter 4.

Compliance Markets. Compliance markets also being established in some states and regions of the United States. The Regional Greenhouse Gas Initiative (RGGI) is a cooperative effort by Northeastern and Mid-Atlantic states to reduce carbon dioxide emissions in the region. Participating states include Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. RGGI states are proposing to regulate carbon dioxide emissions from power plants through a regional cap-and-trade system. RGGI has established its own emissions trading program and a specific methodology for landfills to provide greenhouse gas offsets to this market.

California enacted a bill (AB-32) in 2006 that requires the Air Resources Board to establish rules to reduce greenhouse gas emissions. More information is available in a fact sheet from the California Environmental Protection Agency. The Western Climate Initiative — including Arizona, California, Montana, New Mexico, Oregon, Utah, and Washington, and Canadian provinces — is working to develop a regional greenhouse gas reduction program, including a cap and trade system. As these and other mandatory programs are developed they might create additional revenue streams, depending on whether the final rules allow landfills to provide greenhouse gas offsets.

Renewable Energy Attributes of LFG Energy Projects

LFG energy project developers/owners have opportunities to sell the renewable energy attributes of an LFG electricity project through several potential markets. Transactions in these markets provide value based on the reduction in use of fossil fuels to create energy (electrical or thermal) when LFG energy projects are implemented.

Renewable Energy Certificates. Many states have or are adopting Renewable Portfolio Standards (RPS). A state RPS requires an electrical supplier, provider, or distributor who sells to retail customers (i.e., an "electric services provider") to include a minimum percentage of electricity from renewable generation. Typically, the electric services provider can meet the minimum percentage by purchasing renewable generation attributes from anywhere within the state or regional electric control area. Many state RPS programs group or "tier" the various types of renewable technologies based on which technologies a state wants to encourage. The RPS requirements are creating competitive markets for renewable attributes from renewable energy projects, including LFG-fired generation. Renewable energy certificates (RECs) are the tradable units that allow electric services providers to meet RPS requirements; a typical REC represents the environmental attributes of 1 megawatt-hour of electrical generation delivered to the grid. Pricing for RECs varies greatly by state, depending on the RPS regulations and supply and demand for a given renewable generation technology. RECs can also be sold through voluntary markets. This is more commonly done in states without RPS requirements or access to RPS programs within the region. LFG energy project developers and owners should investigate their options to sell RECs generated by the project and should consider obtaining the assistance of a broker or consultant to maximize REC value. The U.S. EPA Green Power Partnership Web site has more information on RECs.

Greenhouse Gas Displacement Credits. An LFG energy project can generate greenhouse gas emissions reduction credits by displacing more carbon-intensive forms of electric generation on the grid, such as coal and natural gas. Typically, LFG electricity-generating projects may not simultaneously sell RECs and obtain greenhouse gas emission reduction credits for the displacement of fossil fuels, because this is considered selling the same environmental attribute twice. However, LFG electricity projects that do not sell RECs (and do not sell the renewable attributes of the energy to their power purchaser by other means) can receive greenhouse gas emissions reduction credits for the destruction of the LFG if their power sales agreements allow for such sales. Additionally, some programs provide greenhouse gas credits for the displacement of fossil fuel use by LFG energy projects that produce thermal energy.

Agreements to sell renewable energy attributes of LFG energy projects can improve the financial feasibility of LFG energy projects, so landfill owners, LFG energy project developers, and investors should carefully scrutinize contracts and agreements regarding ownership and sale of these attributes.

5.4 Overview of Federal Regulations and Permits

The following section discusses federal regulations that may pertain to LFG energy projects. Landfills and LFG energy projects can be subject to air quality, solid waste, and water quality regulations and permitting requirements. The federal regulations are presented in general terms because individual state/local governments typically develop their own regulations for carrying out the federal mandates. Specific requirements may therefore differ among states. Further information for selected states is available in LMOP's State Primers. Project developers will need to contact relevant federal agencies and state agencies for more detailed, current information and to obtain permit applications for various types of construction and operating permits.

Clean Air Act (CAA)

The CAA regulates emissions of pollutants to protect the environment and public health. The CAA contains four provisions that may affect LFG energy projects: (1) NSPS and Emission Guidelines (EG), (2) National Emission Standards for Hazardous Air Pollutants (NESHAP), (3) New Source Review (NSR) permitting, and (4) Title V permitting.

NSPS and EG for Municipal Solid Waste (MSW) Landfills. LFG energy projects can be part of a compliance strategy to meet EPA's emission standards for LFG. MSW landfills meeting certain design capacity, age, and emissions criteria are required to collect LFG and either flare it or use it for energy. Under the NSPS and EG, large landfills that are greater than or equal to 2.5 million megagrams (Mg) and 2.5 million cubic meters in design capacity and have estimated emissions of non-methane organic compounds (NMOCs) of at least 50 Mg per year must reduce their emissions of LFG. The regulations identify NMOCs as a surrogate for LFG. Therefore, the emission reductions required in the rules are specified as reductions of NMOC. Landfills can use flares or energy recovery projects to meet the emission reduction requirements. LFG emissions were targeted in these rules because of the potential negative impact on human health and the environment from the volatile organic compounds contained in the gas. In addition, the contribution of LFG to local smog

formation, local odors, and potential for explosions or landfill fires were included in the decision-making process. LFG energy projects reduce these health and environmental impacts.

For landfills that commenced construction, reconstruction, or modification on or after May 30, 1991 ("new landfills") the NSPS (40 CFR Part 60 Subpart WWW) apply. For older landfills that received waste after November 8, 1987 ("existing landfills"), the EG (40 CFR Part 60 Subpart Cc) apply. The collection and control requirements in each of these standards are the same; only the start of the compliance clock differs. However, the federal NSPS directly applies to new landfills, whereas the EG for existing landfills are implemented through either a federal plan or EPA-approved state plans. Individual state plans must be similar to, but might not be identical to, the EG. Therefore, landfills and developers should review the applicable state rules for existing landfills.

The final regulations for NSPS/EG can be found in the Federal Register, March 12, 1996, Vol. 61, No. 49, pages 9,905 to 9,944; amendments/corrections can be found in the Federal Register, February 24, 1999, Vol. 64, No. 36, pages 9,257 to 9,262. Complete regulations including the amendments are contained in the Code of Federal Regulations (CFR) subparts listed above. Additional clarifications and amendments have been proposed but are not yet final: see the Federal Register, September 8, 2006, Vol. 71, No. 174, pages 53,271 to 53,293 and the Federal Register, May 23, 2002, Vol. 67, No. 100, pages 36,475 to 36,481. These Federal Register notices and future proposed and final amendments to the NSPS and EG are available on the landfill page of EPA's Air Toxics Web site.

The NPSP and EG require collection and control of LFG at landfills meeting both of the following criteria:

- Capacity — maximum design capacity greater than or equal to 2.5 million Mg (about 2.75 million tons) and 2.5 million cubic meters. (Note that reporting is required for all facilities that meet this criterion, even if they do not meet the emission criterion.)

- Emissions — annual estimated uncontrolled NMOC emission rate is greater than 50 Mg (about 55 tons) per year.

Landfills that meet these criteria must install and operate LFG collection systems as described in the rule. The collected LFG can either be (1) combusted in an open flare that meets design and operating specifications in the rule or (2) combusted in an enclosed combustor (e.g., enclosed flare, boiler, internal combustion engine, or gas turbine) that achieves 98 percent NMOC destruction or 20 parts per million by volume NMOC concentration at the combustion device outlet. A third alternative is to treat the LFG prior to combustion for energy recovery. If the gas is treated, then the energy recovery device does not need to meet the NMOC emission limits or emissions testing requirements. For information on whether the level of treatment being considered for an LFG energy project allows for compliance using this rule option, contact the state air agency or the EPA regional office.

NESHAP. LFG energy projects can be part of a compliance strategy to meet EPA's landfill NESHAP. Under this rule, landfills meeting certain design capacity, age, and emissions criteria are required to collect LFG and to either flare it or use it for energy.

The regulations for MSW landfills under the NESHAP (40 CFR Part 63 Subpart AAAA) affect the same landfills and have the same control requirements as the NSPS/EG. Landfills with design capacities of at least 2.5 million Mg and 2.5 million cubic meters and estimated uncontrolled emissions of NMOCs of at least 50 Mg per year are required to collect and treat or control emissions of LFG. These control requirements are the same as the NSPS/EG with one exception — large landfills (i.e., those that exceed the 2.5 million Mg and 2.5 million cubic meters thresholds) that operate part or all of the landfill as a bioreactor must install collection and control systems for the bioreactor earlier than would be required by the NSPS, even if total estimated emissions do not yet exceed 50 Mg/year. The control systems may also be removed from bioreactors earlier. Bioreactors generate LFG more quickly than conventional landfills, but also generate the gas for a shorter period of time.

The NESHAP also contain more record-keeping and reporting requirements than the NSPS. Landfills that are required to collect and control LFG must develop a startup, shutdown, and malfunction (SSM) plan and must report SSM events. The NESHAP also require semi-annual compliance reporting, instead of the annual reporting required by the NSPS. The NESHAP define types of deviations from the standards that must be reported in the semi-annual reports (for example, periods when monitored control device operating parameters are outside of specified ranges). The final regulations for NESHAP can be found in the Federal Register, January 16, 2003, Vol. 68, No. 11, pages 2,227 to 2,242, available on the EPA Air Toxics Web site landfill page. The final NESHAP, including any amendments, are also published in the CFR subpart previously listed.

Overview of NSR Permitting. New LFG energy projects may be required to obtain construction permits under NSR. Depending on the area in which the project is located, obtaining these permits may be the most critical aspect of project approval. The combustion of LFG results in emissions of carbon monoxide, oxides of nitrogen, and particulate matter. Requirements vary for control of these emissions depending on local air quality. Applicability of the NSR permitting requirements to LFG energy projects will depend on the level of emissions resulting from the technology used in the project and the project's location (i.e., attainment or nonattainment area).

CAA regulations require new stationary sources and modifications to existing sources of certain air emissions to undergo NSR before they begin construction. The purpose of these regulations is to ensure that sources meet the applicable air quality standards for the area in which they are located. Because these regulations are complex, a landfill owner/operator may want to consult an attorney or expert familiar with NSR for more information about permit requirements.

The CAA regulations for attainment and maintenance of ambient air quality standards regulate six criteria pollutants: ozone, nitrogen dioxide, carbon dioxide, particulate matter, sulfur dioxide, and lead. The CAA authorizes EPA to set both health- and public welfare–based national ambient air quality standards (NAAQS) for each criteria pollutant. Areas that meet the NAAQS for a particular air pollutant are classified as being in "attainment" for that pollutant and those that do not are in "nonattainment." Because each state is required to develop an air quality implementation plan (called a State Implementation Plan or SIP) to attain and maintain compliance with the NAAQS in each Air Quality Control Region within the state, specific permit requirements will vary by state. (See 40 CFR 51.160-51.166 for more information on the requirements for developing SIPs including processes

for review of new sources and modifications to ensure that they do not interfere with attaining or maintaining the NAAQS.)

The location and size of the LFG energy project will dictate what kind of construction and operating permits are required. If the landfill is located in an area that is in attainment for a particular pollutant, the LFG energy project may have to undergo Prevention of Significant Deterioration (PSD) permitting. Nonattainment area permitting is required for those landfills that are located in areas that do not meet the NAAQS for a particular air pollutant. Furthermore, the estimated level of emissions from the project determines whether the project must undergo major NSR or minor NSR. The requirements of major NSR permitting are greater than those for minor NSR. The following provides more detail on new source permits:

PSD Permitting. PSD review is used in attainment areas to determine whether a new or modified emissions source will cause significant deterioration of local air quality. Permit applicants must determine PSD applicability for each individual pollutant. For each pollutant for which the source is considered major, the PSD major NSR permitting process requires that the applicants determine the maximum degree of reduction achievable through the application of available control technologies. Specifically, major sources may have to undergo any or all of the following four PSD steps:

- Best available control technology (BACT) analysis.
- Monitoring of local air quality.
- Source impact analysis/modeling.
- Additional impact analysis/modeling (i.e., impact on vegetation, visibility, and Class I areas). (See 40 CFR Part 52.21 for more information on PSD.)

Minor sources and modifications are exempt from this process, but these sources must still obtain state construction and operating air permits. Contact the state agency for details and applications.

Nonattainment NSR Air Permitting. A source in an area that has been designated in nonattainment for one or more of the six criteria pollutants may be subject to the nonattainment classification for such pollutants. Ozone is the most pervasive nonattainment pollutant and the one most likely to affect LFG energy projects. Because oxides of nitrogen contribute to ambient ozone formation, ozone nonattainment can lead to stringent control requirements for oxides of nitrogen emitted from LFG energy projects. A proposed new emissions source or modification of an existing source located in a nonattainment area must undergo nonattainment major NSR if the new source or the modification is classified as major (i.e., if the new or modified source exceeds specified emissions thresholds). To obtain a nonattainment major NSR permit for criteria pollutants, a project must meet two requirements:

- Must use technology that achieves the lowest achievable emissions rate (LAER) for the nonattainment pollutant.

- Must arrange for an emissions reduction at an existing combustion source that offsets the emissions from the new project at specific ratios.

Title V Operating Permit Process. Many LFG energy projects must obtain operating permits that satisfy Title V of the 1990 CAA Amendments. Any LFG energy plant that is a major source, or is part of a major source, as defined by the Title V regulation (40 CFR Part 70), must obtain an operating permit.

Title V of the CAA requires that all major sources obtain new federally enforceable operating permits. Each major source must submit an application for an operating permit that meets guidelines spelled out in individual state Title V programs. The operating permit describes the emission limits and operating conditions that a facility must satisfy and specifies the reporting requirements that a facility must meet to show compliance with all applicable air pollution regulations. Therefore, the Title V permit will incorporate the specific requirements of the NSPS, EG, NESHAP, PSD, and/or nonattainment NSR that have been determined to apply to the individual LFG energy project. A Title V operating permit must be renewed every five years.

Resource Conservation and Recovery Act (RCRA) Subtitle D

Before an LFG energy project can be developed, all RCRA Subtitle D requirements (i.e., requirements for non-hazardous solid waste management) must be satisfied. In particular, methane is explosive in certain concentrations and poses a hazard if it migrates beyond the landfill facility boundary. LFG collection systems must meet RCRA Subtitle D standards for gas control.

Since October 1979, federal regulations promulgated under Subtitle D of RCRA require controls on the migration of LFG. In 1991, EPA promulgated landfill design and performance standards. These newer standards apply to MSW landfills that were active on or after October 9, 1993. Specifically, the standards require monitoring of LFG and establish performance standards for combustible gas migration control. Monitoring requirements must be met at landfills not only during their operation, but also for 30 years after closure.

Landfills affected by RCRA Subtitle D are required to control gas by establishing a program to periodically check for methane emissions and prevent off-site migration. Landfill owners and operators must ensure that the concentration of methane gas does not exceed:

- Twenty-five percent of the lower explosive limit for methane in facilities' structures.
- The lower explosive limit for methane at the facility boundary.

Permitted limits on methane levels reflect the fact that methane is explosive within the range of 5 to 15 percent concentration in air. If methane emissions exceed permitted limits, corrective action (i.e., installation of an LFG collection system) must be taken. Subtitle D may give some landfills an impetus to install energy recovery projects in cases where a gas collection system is required for compliance (see 40 CFR Part 258 for more information).

National Pollutant Discharge Elimination System (NPDES) Permit

LFG energy projects may need to obtain NPDES permits for discharging wastewater that is generated during the energy recovery process. LFG condensate forms when water and other vapors condense out of the gas stream due to temperature and pressure changes within the LFG collection system. This

wastewater must be removed from the collection system. In addition, LFG energy projects may generate wastewater from system maintenance.

NPDES permits regulate discharges of pollutants to surface waters. The authority to issue these permits is delegated to state governments by EPA. The permits, which typically last five years, limit the quantity and concentration of pollutants that may be discharged. To ensure compliance with the limits, permits require wastewater treatment or impose other operating conditions. The state water offices or EPA regional office can provide further information on these permits.

The permits are required for three categories of sources and can be issued as individual or general permits. An LFG energy project would be included in the "wastewater discharges to surface water from industrial facilities" category and would require an individual permit. An individual permit application for wastewater discharges typically requires information on:

- Water supply volumes
- Water utilization
- Wastewater flow
- Characteristics and disposal methods
- Planned improvements
- Storm water treatment
- Plant operation
- Materials and chemicals used
- Production
- Other relevant information

Clean Water Act (CWA) Section 401

LFG energy projects may need CWA Section 401 certification for constructing pipelines that cross streams or wetlands. LFG recovery collection pipes or distribution pipes from the landfill to a nearby end user may cross streams or wetlands. When construction or operation of such pipes causes any discharge of dredge into streams or wetlands, the project may require CWA Section 401 certification.

The applicant must obtain a water quality certification from the state in which the discharge will originate. The certification should then be sent to the U.S. Army Corps of Engineers. The certification indicates that such discharge will comply with the applicable provisions of Sections 301, 302, 303, 306, and 307 of the CWA.

Other Federal Permit Programs and Regulatory Requirements

The following are brief descriptions of how other federal permits could apply to LFG energy project development:

- RCRA Subtitle C could apply to an LFG energy project if it produces hazardous waste. While some LFG energy projects can return condensate to the landfill, many dispose of it through the public sewage system after some form of on-site treatment. In some cases, the

condensate may contain high enough concentrations of heavy metals and organic chemicals for it to be classified as a hazardous waste, thus triggering federal Subtitle C regulation.

- The Historic Preservation Act of 1966 or the Endangered Species Act could apply if power lines or gas pipelines associated with a project infringe upon a historic site or an area that provides habitat for endangered species.

- Requirements of the Uniform Relocation Assistance and Real Property Acquisitions Act of 1970, as amended, (Uniform Act) will apply to LFG energy projects, if federal funds are used for any part of project design, right-of-way acquisition, or construction. The Federal Highway Administration is the lead agency for issues concerning the Uniform Act.

Project developers will need to contact relevant federal, state, and local agencies for more detailed information on how the various federal, state, and local regulations would apply to a particular LFG energy project.